Flight Plan Monitoring using Agent-Based Technology

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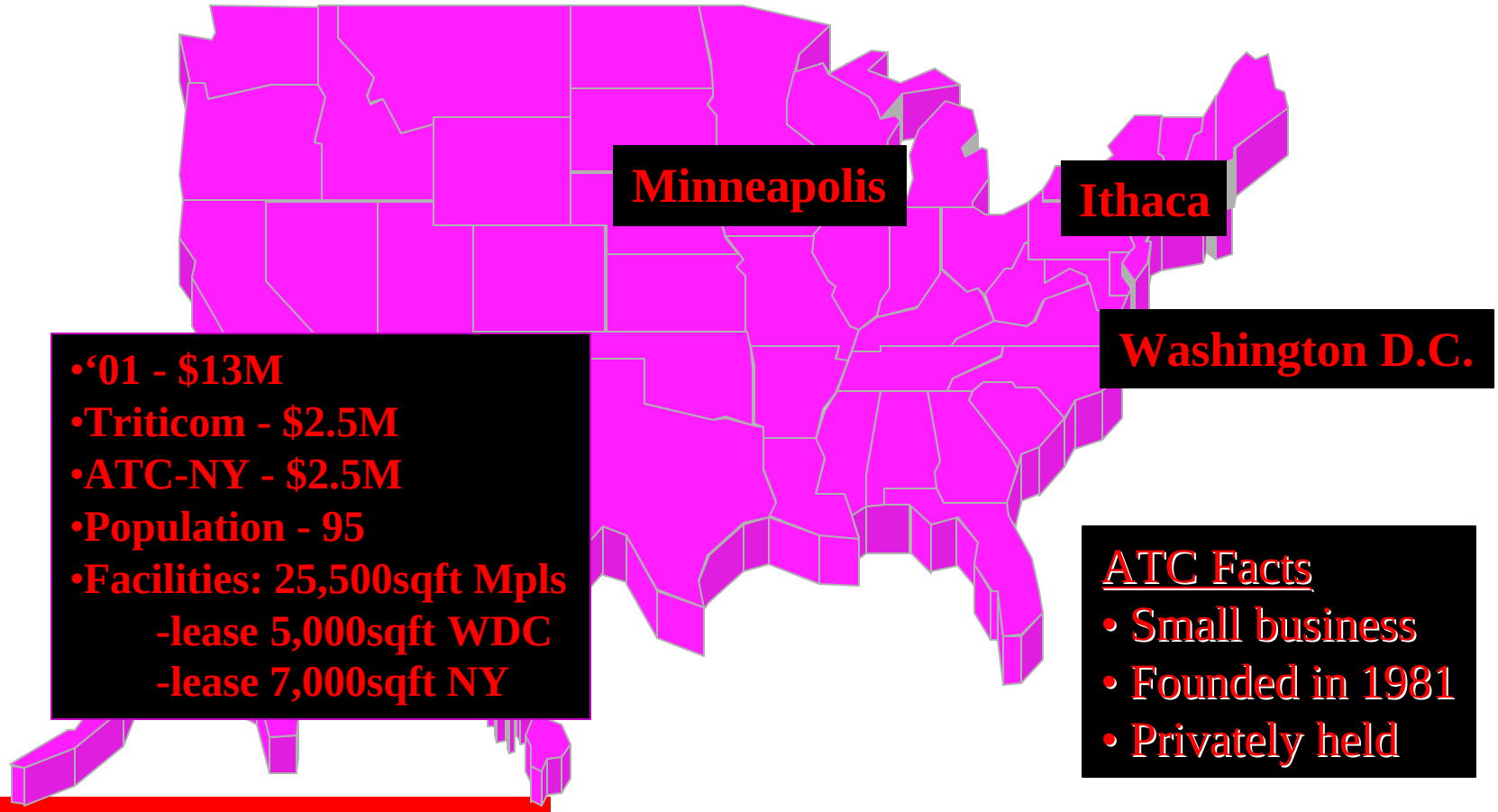
ATC Operations



- '01 - $13M
- Triticom - $2.5M
- ATC-NY - $2.5M
- Population - 95
- Facilities: 25,500sqft Mpls
  - -lease 5,000sqft WDC
  - -lease 7,000sqft NY

ATC Facts

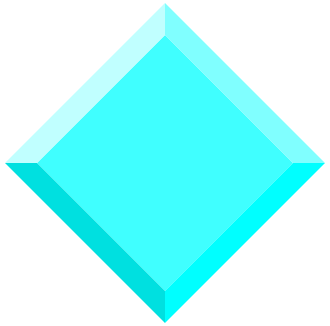
- Small business
- Founded in 1981
- Privately held

Architecture Technology Corporation
Specialists in Computer Architecture

Civil Aviation Flight Path Monitoring and Anomaly Detection (CAFMAD)

Problem Statement: Monitoring aircraft and airports for conformance to prearranged flight path and expected behavior

- Lightweight, scalable, flexible approach
- Identify anomalies that can lead to problems
- Responsive / reactive, yet directed / controllable
- Report specific and relevant information to operator
- High detection and low false alarm rates



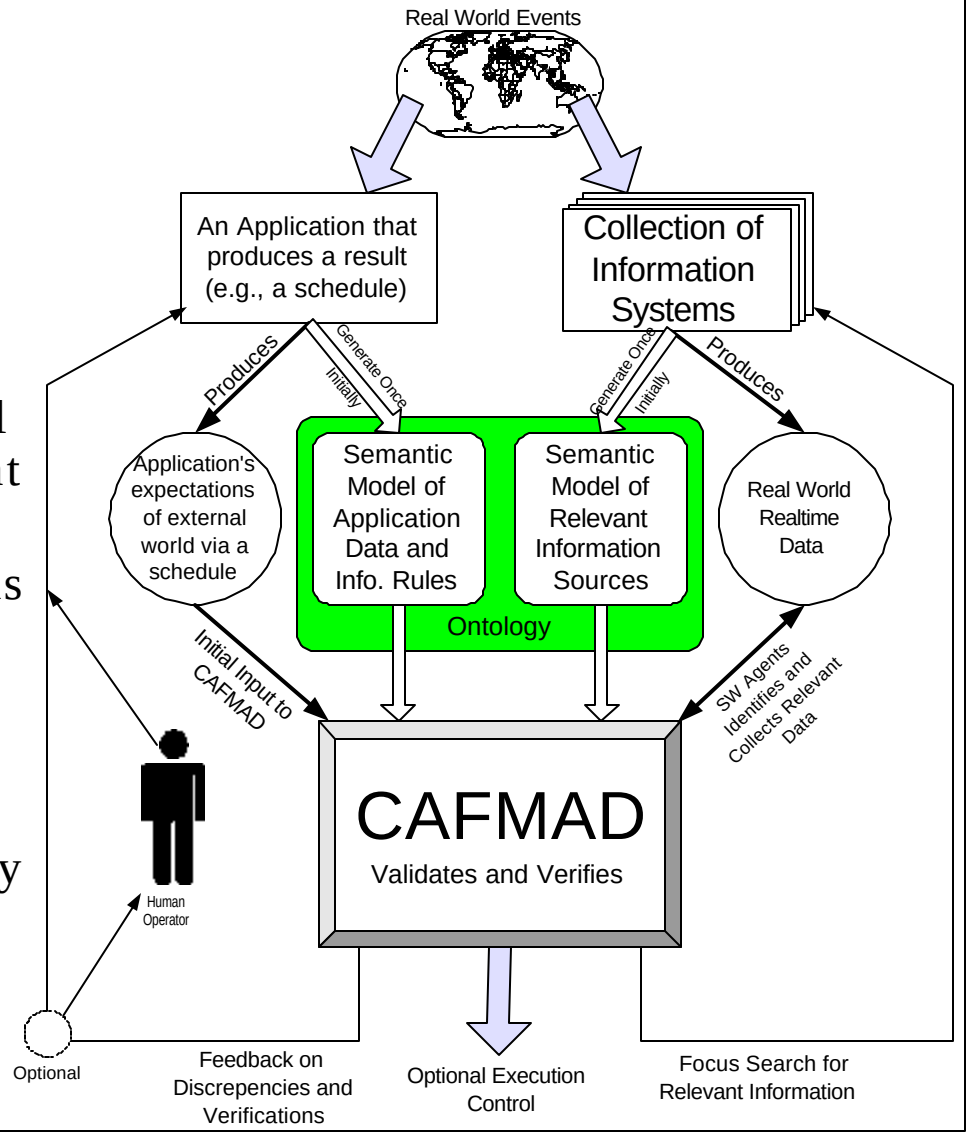
What, Why, and How...

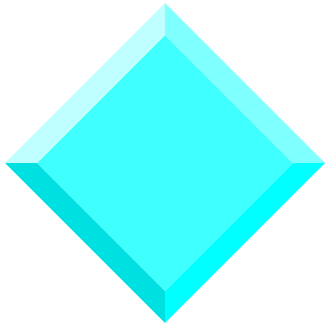
- **CAFMAD:** identify, collect, match, and update data:
  - Verify the expected results of aircraft schedules, flight paths, and other airport activities
  - Determine information "relevant" to verification
  - Uses "agents" as intermediaries to external data sources

- **CAFMAD assigns agents (independent processes) to check "actual status" data:**
  - build a cross-reference of semantic descriptions for the relevant data and information (an ontology)
  - intelligent processes operate over the ontology.

CAFMAD Information Validation Concept

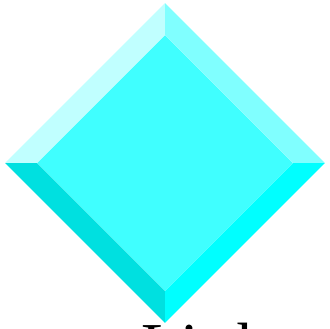
- National Airspace System Applications produce schedules and activity expectations
- CAFMAD uses schedules, etc. to identify expectations upon the real world and the information relevant to verifying the expectations
- Relevant information is collected as needed and compared to expectations
- Specific anomalies and dangerous situations can also be searched for
- SW agents collect and continuously compare data to expectations





CAFMAD Approach

- Tracking flight path for non-allowable variances
- Allows dynamic rearrangement of flight paths
- Timely response to deviations
- Monitor for other airspace anomaly activities
  - e.g., reported airport security breaches
- Identify anomalies
  - Single significant event that signals a problem
  - Collections of individually-insignificant events that together constitute a problem
  - Deviations from expected data or outcomes

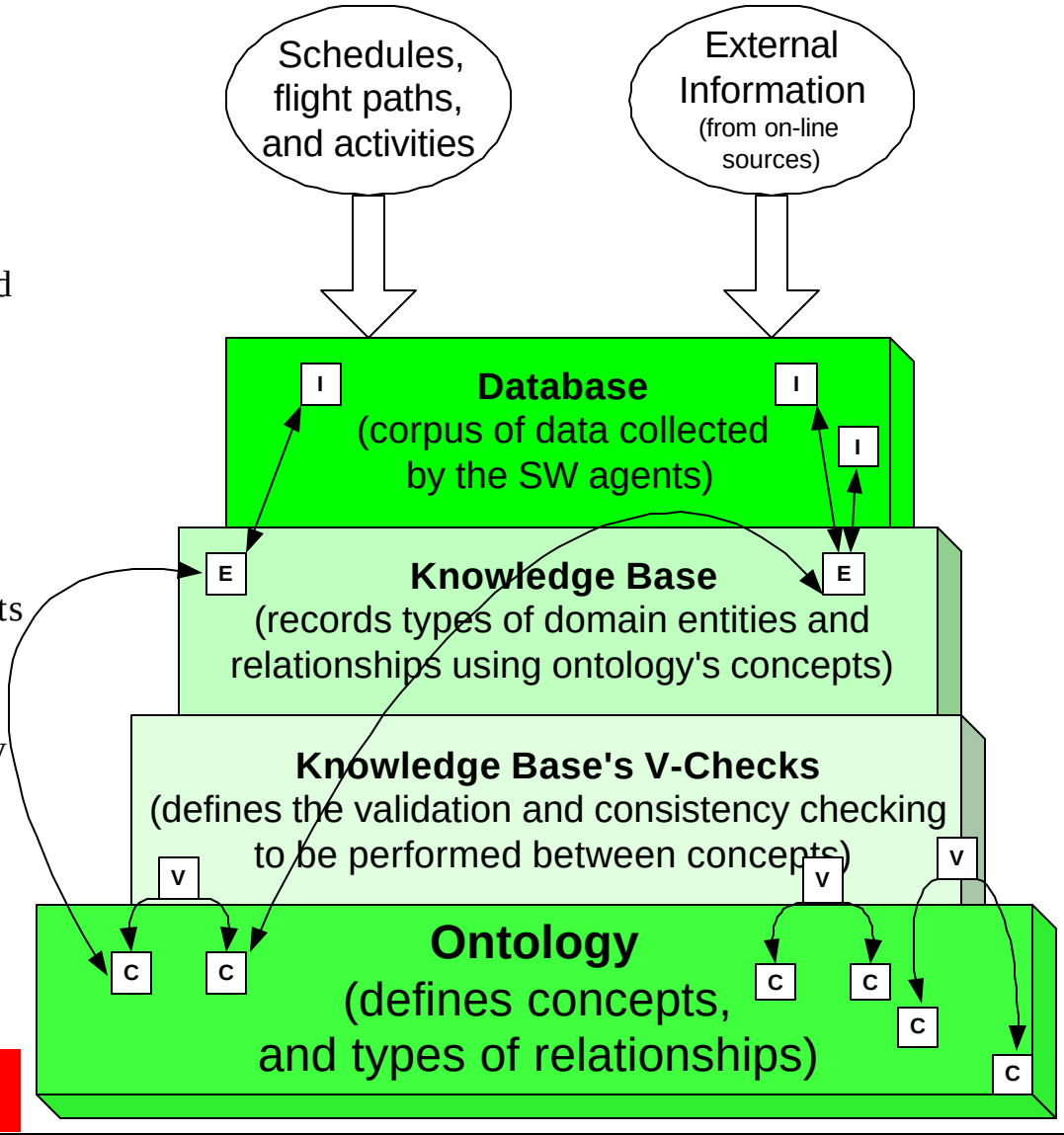


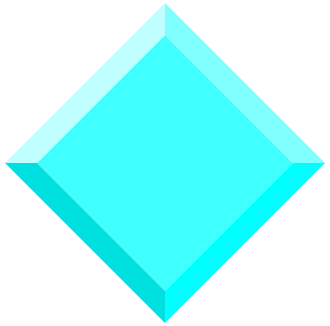
CAFMAD Components

- Lightweight Agent Architecture
- Verification Engine
- Ontology, Knowledge Base and Database

Expectation Verification Checking

- Items (I) are collected or given to CAFMAD's agents (e.g., an aircraft's schedule and flight path)
- Items are mapped to known real world entities (E) in the knowledge base (e.g.,embarkation airport is MSP)
- Relationships exist between entities and concepts (C) (e.g., MSP is a hub airport for NWA)
- V-Checks (V) are used to define verification processes between concepts (e.g., aircraft must remain on flight path within tolerances unless ….)
- Mapped associations are used to apply V-Checks between the schedule items and collected data items (ETMS states flight is at location outside tolerances)
- Inconsistencies are flagged
- Operator can control V-Check operation (when, how often, etc.)





Summary

- Independent “expectation verification” system applicable to any dynamic execution or information process
- Improves schedule monitoring efficiency
  - Provides more up-to-date status of the schedule
  - Allows a more responsive and dynamic scheduling capability
  - Requires less time to collate information
  - Frees up operator’s time to concentrate on problem solving
- Independent verification of schedules in near real-time, across entire schedule
  - Operator will define when and how often to perform checking
- Provides critical support for accessing multiple, dynamic, external, on-line data source environment
- Displays to the operator “drill-down” details of the discovered mission schedule inconsistencies and invalid assumptions